

**ARMY SMALL BUSINESS INNOVATION RESEARCH PROGRAM  
SUBMITTING PROPOSALS ON ARMY TOPICS**

Phase I Proposals (5 copies) should be addressed to:

**Topics #1 through #17**

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**Topics #67 through #75**

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**Topic #86**

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**Topics #87 through #102**

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**Topics #103 through #108**

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Alexandria, VA 22333-0001

**Topics #109 through #111**

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### **Army Research Topics for FY85 SBIR Solicitation**

A85-001            TITLE: MICRO-MINIATURE ELECTRONIC/OPTICAL ROLL RATE SENSOR FOR IMPROVED SMART MUNITIONS PERFORMANCE

CATEGORY: Exploratory Development

DESCRIPTION: Currently manufactured roll rate sensors are expensive to manufacture, have significant power consumption and require storage of compressed gasses on board. New and innovative roll rate sensor designs are sought which will have similar to better performance specifications but none of the currently experienced design shortcomings. Ideally, such a design concept will be of a smaller size and lighter weight than the present concept and further enable a reduction of the overall projectile weight through reduced power requirements and elimination of on-board storage of compressed gas. The sensor's output should be digital and thereby reduce the time required for interrogation by the system's guidance computer.

A85-002            TITLE: MICRO-MINIATURE ELECTRONIC/OPTICAL ACCELERATION SENSOR FOR IMPROVED SMART MUNITIONS PERFORMANCE

CATEGORY: Exploratory Development

DESCRIPTION: Innovative approaches for acceleration sensors are needed with improved performance capabilities. Improvements in guidance technology are dependent on development of acceleration sensors with wider ranges of operation and capabilities for multi-dimensional resolution of applications for angle of linear rate sensing and which will encourage digital signal processing. The acceleration sensor should be of minimal size and weight while retaining the performance requirements for guided projectile applications.

A85-003            TITLE: MICRO-MINIATURE ELECTRONIC/OPTICAL SAFE SEPARATION SENSOR FOR IMPROVED SMART MUNITIONS PERFORMANCE

CATEGORY: Exploratory Development

DESCRIPTION: Existing technologies applied to acceleration sensors for detection of safe separation distance and timing are unsuitable due to limited range, size, reliability, ruggedness and cost. Novel concepts for an intrinsically stable and simple accelerometer for safe separation sensors for guided and smart munitions are therefore sought. The desired accelerometer should be a micro-miniature device of absolute minimum dimensions. Its range of operation should be within fractions of a G to tens of G's. By design, the proposed concept should be able to withstand rough handling, wide ranges of ambient temperatures, and random launch and flight vibrations.

A85-004            TITLE: MICRO-MINIATURE ELECTRONIC/OPTICAL MAGNETIC MOMENT SENSOR FOR IMPROVED SMART MUNITIONS PERFORMANCE

CATEGORY: Exploratory Development

DESCRIPTION: The development of compact, high sensitivity, moderate magnetometer technology. Large magnetic moments generally represent real targets, which are not as easily or cheaply produced as other decoys. Thus, incorporation of magnetic moments sensors into a "smart" projectile targeting system could improve overall performance by rendering it less vulnerable to decoys. Innovative concepts are sought which will encourage this sensing technology. Other potential applications include magnetic antennas for detection of EM signals and compass headings.

A85-005            TITLE: DYNAMIC HIGH PRESSURE – HIGH TEMPERATURE DIAGNOSTICS

CATEGORY: Exploratory Development

DESCRIPTION: Innovative approaches are solicited for the measurement of pressure and temperature in the hostile environments of gun interiors. Diagnostics which are applicable at temperatures in the range of 3000°k and pressures of 700 MPa are required. The sensors must respond to dynamic fluctuations with rise times of 0.1 msec or less. The proposals should address novel approaches to the requirement for rugged sensors and techniques which can be used to measure interior ballistic parameters such as pressure, temperature, and heat transfer in large caliber (105mm and greater) guns.

A85-006            TITLE: ADVANCED GUN PROPULSION TECHNOLOGY

CATEGORY: Exploratory Development

DESCRIPTION: Development of advanced solid and liquid propellant gun systems offers the potential for application of new technology in several areas. Characterization of liquid propellant systems is of considerable interest including ignition and combustion aspects and flow visualization. Proposals are solicited which address the design, improvement, and development of gun propulsion systems and propelling charge design. Areas of interest include development of novel energetic materials for igniters and propellants, novel methods of ignition, application of advanced diagnostics to ignition and combustion and muzzle flash characterization, measurement of in-bore projectile acceleration and other new technology which can be applied to develop more efficient and higher performance gun systems.

A85-007            TITLE: ADVANCED FIBER OPTIC TECHNOLOGY

CATEGORY: Exploratory Development

DESCRIPTION: Significant advances are being made in fiber optic sensor technology and the complementary digital data processing equipment required for data acquisition and reduction. It is feasible to consider one-time use sensor elements which are capable of measuring pressure, temperature, and mechanical stresses. This advanced sensor technology should be exploited for us in measuring interior ballistic parameters such as chamber pressure, flame temperature, projectile acceleration and projectile-tube interactions. Proposals are solicitation for innovative approaches to employing fiber optic technology to characterize interior and in-bore ballistic in large caliber guns.

A85-008            TITLE: MATERIAL REPLACEMENT

CATEGORY: Basic Research

DESCRIPTION: Develop a suitable replacement for Nylon 6/6 for ammunition applications that will not be affected by explosives, propellants, or humidity.

A85-009            TITLE: GUN BARREL DEVELOPMENT

CATEGORY: Exploratory Development

DESCRIPTION: Develop a composite/ceramic gun barrel that will be substantially lighter and have the same service life as the steel barrels now used on small caliber ammunition.

A85-010            TITLE: COMPOSITE MATERIAL SHEAR STRENGTH

CATEGORY: Exploratory Development

DESCRIPTION: A method is needed to substantially increase the shear strength of molded threads and flanges fabricated by compression molding of discontinuous fiber reinforced molding compound.

A85-011            TITLE: FRACTURE TOUGHNESS CHARACTERIZATION OF FILIMENTARY METAL MATRIX COMPOSITE MATERIALS SYSTEMS

CATEGORY: Basic Research

DESCRIPTION: The discipline of fracture mechanics is widely used in assessing the safety and reliability of military equipment; at the present stage of development this science assumes the materials are homogenous and isotropic. Most of our commonly utilized material systems reasonably meet these assumptions. However, in the future, filament reinforced metal matrix composite material will be applied. It will be necessary to determine the fracture toughness of this class of materials which do not meet the homogenous and isotropic assumptions. Innovative research and approaches are required to develop a methodology for determining this characteristic of metal matrix composites.

A85-012            TITLE: LIGHTWEIGHT ARMAMENT SYSTEMS

CATEGORY: Exploratory Development

DESCRIPTION: The highly mobile and lightweight nature of future combat forces requires lightweight armament systems for light vehicle, air defense and aircraft applications. The need exists to significantly lighten present weapons systems and munitions, with no loss in effectiveness, through the use of advanced lightweight materials including composites, ceramics and plastics in weapon structural elements and operating components. The effects of such materials substitutions on system weight, operation characteristics, effectiveness, and reliability and maintainability should be investigated.

A85-013            TITLE: ARTIFICIAL INTELLIGENCE ROBOTICS

CATEGORY: Basic Research

DESCRIPTION: A basic research program which has been initiated encompasses the fields of Artificial Intelligence and Robotics for applications to weapon platform control and fire control systems. The thrust of the program is to develop a fundamental understanding of symbolic processing with specific applications to machine learning, adaptive control, machine vision and expert systems.

A85-014            TITLE: MACHINE VISION

CATEGORY: Exploratory Development

DESCRIPTION: Techniques or mathematical algorithms applicable for machine recognition of patterns are desired in support of fire control subsystems capable of recognizing targets on the battlefield. Emphasis is placed on efficient coding of target controls and on fast (real time) processing algorithms.

A85-015            TITLE: OPTICAL PROCESSING

CATEGORY: Exploratory Development

DESCRIPTION: Integrated optical processors have a high potential for applications to Army fire control because of the intrinsic time-bandwidth constants available using guided electromagnetic waves rather than conducting electronics for transmitting and processing data. Methods of fabricating integrated optical processors are solicited as well as theoretical research leading to fundamental understanding of integrated optics phenomena.

A85-016            TITLE: ARMAMENT SYSTEM SOFTWARE QUALITY – SOFTWARE TEST DRIVER DESIGN

CATEGORY: Exploratory Development

DESCRIPTION: There is a need for developing a generic prototype test driver which utilizes the concepts of structured testing and test path analyses. A proposed solution to this would be to obtain selected commercially available tools, verify their performance, modify and consolidate tools to create the prototype, and then write a tailored user's manual for the Battlefield Automated Systems' tool. The objective of this would be to demonstrate that the developed software conforms to the system requirements and that a uniform level of confidence is achieved.

A85-017            TITLE: ARMAMENT SYSTEM SOFTWARE QUALITY – REQUIREMENT ANALYSIS MEASURES

CATEGORY: Exploratory Development

DESCRIPTION: The critical task in developing software is the incorporation of design requirements into computer code. The correct implementation of requirements into the code is assessed by analyzing the requirements in terms of completeness, traceability, and consistency. These attributes must be evaluated before coding takes place. There is a need for measuring these attributes in a consistent means on all software development programs to assure that the project is ready for coding. SQAM Knowledge Engineering Data Base – Software Quality Assessment and Measurement is the control loop to the software development process. There is a need for an artificial intelligence, knowledge engineering, and database to offset what will continue to remain a critical shortage of qualified SQAM personnel in the Army.

A85-018            TITLE: STABILIZATION OF BIOMATERIALS

CATEGORY: Exploratory Development

DESCRIPTION: Thermophilic and halophilic microbes have evolved novel means of protecting DNA, RNA, enzymes, and other proteins from denaturation under environmentally hostile conditions. The use of antibodies in dipsticks for threat agents and toxins, and the use of antibodies, enzymes, and natural receptor sites in artificial membranes as coatings for biomicrosensors (optical waveguides, surface acoustic-wave probes, piezoelectric crystals, chemical field-effect transistors) will require advanced methods of stabilization of proteins. The goal is to enhance shelf life of such items under field and ship-board conditions.

A85-019            TITLE: BIOMICROSENSOR TECHNOLOGY

CATEGORY: Exploratory Development

DESCRIPTION: Research and development should focus on: new methods of transduction of recognition events (antibody, enzyme, neural receptor sites) into electrical or optical signals; means to modify surfaces with biomaterials; methods of recognition amplification (including cascade systems) such that input is magnified in sequence using either regenerative or slow depletion phenomena; micro encapsulation; and biomaterial-based detectors configured without liquid flow.

A85-020            TITLE: MINIATURE PUMP FOR MASS SPECTROMETER CHEMICAL AGENT DETECTORS

CATEGORY: Exploratory Development

DESCRIPTION: A need exists to develop a small and rugged pump, which could be used as the primary pumping system for future miniature mass spectrometer systems. This pump would be designed around the pumping requirements necessary to support the operation of an Atmospheric Pressure Ionization Tandem Mass Spectrometer (API MS/MS) including the loading due to certain gas and collision gas concerns (repumping requirements for the TAGA 6000 API MS/MS, Sciex). The development effort should address pump designs which can operate in a military environment and while in motion when the system is mounted in/on a vehicle. In addition, the design should address the basic needs of being compact, requiring a minimal of power, and being easily maintained.

A85-021            TITLE: COLORIMETRIC CONCEPTS FOR RESIDUAL FILTER LIFE INDICATOR

CATEGORY: Exploratory Development

DESCRIPTION: A simple, reliable method is required to indicate to the user of a gas filter the amount of protection remaining. Previous efforts to develop a residual life indicator for gas filters were based on rather sophisticated electronic chemical detectors. These devices proved to be very unreliable and an urgent need for some form of indicator continues to exist. An approach which is considered to offer great promise for simple, reliable performance as a filter life indicator is an application involving the use of colorimetric chemical reactions. Such an indicator approach would provide a color change as the sorptive capacity of the ASC Whetlerite is depleted.

A85-022            TITLE: ACTIVE CONTROL LANDING GEAR

CATEGORY: Exploratory Development

DESCRIPTION: Present approaches to crashworthy landing gears use hydraulic approaches to crash load energy absorption or a hydraulic/mechanical combination system. The hydraulic portion of the system is always loading rate sensitive, meaning that in severe crashes the high shock strut closure rates produce very high spike loads on the entire landing gear structure, causing it to fail before absorbing significant energy. Modern fluidics technology is showing the ability to give interactive control of the hydraulic gear metering function so that a more optimum "square wave" load deflection landing gear characteristic can be obtained at any vertical impact velocity. This program will design and test such a system.

A85-023            TITLE: ADVANCED CRASHWORTHY CREWSEAT

CATEGORY: Advanced Development/Non-systems

DESCRIPTION: The Army's present armored, crashworthy crew seats are a first attempt at protecting the pilots/copilots from the dual hazards of incoming ballistic rounds and injurious loading characteristic of the Army's design crash pulse. During recent years, newer lightweight materials have evolved both in structural components and protective armor and more has been learned about human tolerance to severe impacts. This technology now needs to be applied to design a lighter armored crashworthy crew seat having improved crash protection.

A85-024            TITLE: IMPROVED CREW RESTRAINT SYSTEM

CATEGORY: Advanced Development/Non-Systems

DESCRIPTION: Analysis of recent severe Army helicopter accidents involving aircraft designed to stringent crashworthiness standards has shown the need for a new innovative crew restraint design. The present MIL-R-



58095 five-point restraint fails to control lateral motion of the crewman in severe crashes sufficiently to prevent lateral secondary impacts. The new harness should incorporate revised geometry/strap sizes to better restrain the occupant in the lateral direction.

A85-025            TITLE: IMPROVED THERMOPLASTIC MATRIC FOR COMPOSITE PRIMARY STRUCTURES

CATEGORY: Advanced Development/Non-systems

DESCRIPTION: In order to achieve the full potential of cost and weight reductions of composite material in aircraft primary structures, improved matrix materials for use with advanced fiber materials need to be developed. Thermoplastic has the ability of being thermoformed more rapidly than conventional epoxy systems and possess much longer shelf life properties even at room temperature storage. However, the current thermoplastic material systems do possess two disadvantages for primary structures as compared to their epoxy counterpart. In general, the material properties, especially interlaminar shear, are lower than epoxy systems. Secondly, the high temperature properties degrade more rapidly as the material approaches its original cure temperature than epoxy systems.

A85-026            TITLE: DISTRIBUTED COMMAND AND CONTROL APPLICATIONS – CECOM/CENCOMS

CATEGORY: Basic Research

DESCRIPTION: Emerging Technologies in Distributed Communications and distributed processing offer the potential of improving survivability and effectiveness of Command and Control (C<sup>2</sup>) processes. The five functional system areas which comprise the Army's Command and Control System include maneuver, fire support, air defense, intelligence/EW, and combat service support.

The objective of the thrust is to explore approaches to exploit these technologies to enhance the survivability and effectiveness of C<sup>2</sup> functions and processes. The emphasis of this effort shall be on the approach to survivable C<sup>2</sup> applications rather than on the distributed communications and distributed processing resources that underly these applications. In particular, this emphasis is on novel approaches which utilize advanced technology, e.g. decision aids, and involve synchronization of decision activity areas across several functions or echelons to achieve major gains in survivability and/or effectiveness through use of the underlying in survivability and/or effectiveness through use of the underlying distributed communication and processing resources. Consideration will also be given to novel and effective applications of man-machine interface techniques which are well-matched to specific types of applications and echelon levels. Proposed applications may address any of the five functional areas.

A85-027            TITLE: ARTIFICIAL INTELLIGENCE FOR C<sup>3</sup>I – CECOM/CENTACS

CATEGORY: Exploratory Development

DESCRIPTION: The tactics and doctrine of the modern battlefield dictate the need for intelligent machines to assist human operators. The technology associated with encapsulating knowledge and techniques used in AI to capture the reasoning process that human experts perform promises to provide a significant impact on future computer systems for the military.

Future military systems will be required to be self-learning and interactive. Self-learning systems are systems that are able to make significant changes in their internal processing logic in response to user commands or based on demands which have been placed on the system in the past. These systems are extremely important in a military environment because they create significant operational capabilities across a diverse set of applications. They are fundamentally superior and inherently more reliable than the conventional rigid systems because they can be made more faults tolerant and possibly can be given limited properties of self-diagnosis and self-repair.

In addition to self-adapting systems, the following AI technology advances are required to insure the adequacy of future military systems:

1. improved man/machines interfaces, such as natural language, speech and vision processing
2. the ability to represent and reason with data that is imprecise, incomplete, and not totally reliable and
3. new architectures that will provide the processing speeds and memory requirements as well as new languages and tools that will permit the communications with, and development on, these new machines.

A85-028                      TITLE: IMPROVED WIND PROFILER

CATEGORY: Basic Research

DESCRIPTION: Passive or covert methods for remote sensing of atmospheric winds need to be developed. Vertical profiles of atmospheric winds are needed for Army artillery, aviation operations, and prediction of smoke and chemical weapons effects. Existing methods for measuring atmospheric winds use the radiosonde, long-wavelength radar, or lidar techniques. Each of these suffers from significant defects which limit its usefulness as a field army sensor.

In particular, the radiosonde is bulky, manpower intensive, limited in space and time resolution, and hard to hide on the battlefield. Despite these limitations it continues to be the primary system of determination of battlefield winds.

Long wavelength (50 Mhz to 915 Mhz) radar has been shown capable of measuring atmospheric wind profiles up to tropopause with excellent time resolution on a continuous basis. Such radars require very large antennas and substantial power, however, which would give them enormous signatures on the battlefield, and their sheer size would seem to make deployment a problem. In addition, they are generally unable to measure winds in the lowest several hundred meters of the atmosphere which are usually the most important for army applications.

Lidar wind sensors can overcome many of the objections to the above systems. Like the long-wavelength radars, lidar wind sensors have good time resolution, and even better space resolution. Unlike the radars, they can measure winds near the ground. Lidars using either the cross-correlation technique or the coherent doppler technique would seem to offer the most promise, but they are limited to clear weather and still have substantial bulk.

New ideas and techniques are needed in this area. An ideal wind sensor would be small and passive, or at least relatively covert. It is necessary to measure vertical wind profiles at least to a height of three kilometers and preferably to the tropopause. The vertical resolution should be 100 meters or less in the boundary layer and 500 meters or better above. Velocity resolution of 1 m/sec or better is highly desirable. Even if these ideal standards cannot be met, new ideas are needed for more covert wind sensors, as are ideas that help overcome any of the defects of existing sensors listed above.

A85-029                      TITLE: LIDAR INVERSION AND THE RELATIONSHIP BETWEEN BACKSCATTER AND EXTINCTION

CATEGORY: Basic Research

DESCRIPTION: Remote sensing devices for measuring visibility, cloud height, pollutants, etc., in the atmosphere generally depend on inversion algorithms that convert returned power to the extinction coefficients. In order to construct a solution to the lidar equation one generally assumes a simple power-law relationship between backscatter and extinction, with a fixed exponent and constant of proportionality. It then becomes possible to obtain extinction as a function of range, based on the physical picture that particulate backscatter acts as a distributed mirror by which range-dependent signal information is received.

It is known, however, that the power law representation is a rather idealized approximation, and can be expected to be of dubious value in some circumstances. For example, for a situation in which it is known that the distributed backscatter changes abruptly at the range where one aerosol is imbedded in another, such as for a pollutant cloud in otherwise clear air, the simple fixed power law description is apparently inappropriate. In general, it would be better

to obtain a description that recognizes the fact that the proportionality between backscatter and extinction is itself a function of range, and to incorporate this more accurate physical picture into the inversion process.

A85-030            TITLE: HIGH RELATIVE HUMIDITY MEASUREMENT

CATEGORY: Basic Research

DESCRIPTION: A need exists for the accurate measurement of the wet bulb or dew point temperature to determine relative humidity when it is above 95 percent. It is known that the relative humidity or the amount of moisture in the atmosphere has an important effect upon the growth of natural aerosols and upon the consistency or life span of smoke aerosols. Various chemical, biological, and radiological agents have greater reaction rate when the atmosphere is very moist.

The relative humidity parameter is an important input to several of the atmospheric effects models that the US Army Atmospheric Sciences Laboratory is developing. Obscuration parameters such as fog and smoke depend upon the amount of moisture in the air for their formation and life span. These factors are particularly critical during the period of high relative humidity. A satisfactory technique to measure relative humidity in the 97-100 percent range does not exist. Most instruments become saturated with the ambient moisture and become unreliable and yield inconsistent measurements near 100 percent. This is the period of time when the visibility is critical in the detection, recognition, and guidance of missiles to a target, for example.

A85-031            TITLE: NEW CONCEPTS FOR MILLIMETER WAVE ELECTRONIC SCAN ANTENNAS

CATEGORY: Exploratory Development

DESCRIPTION: To realize low cost compact transducers, a simple electronic scan approach is required for the 30-100 GHz region. Any promising, novel approaches that are simpler than conventional phase array are of interest.

A85-032            TITLE: MILLIMETER WAVE MICROSTRIP CONTROL COMPONENTS

CATEGORY: Exploratory Development

DESCRIPTION: Control components such as circulators, isolators, phase shifters, and switches that are compatible with low cost planar construction in micro strip or similar format are sought for the 30-100 GHz region.

A85-033            TITLE: SOLID STATE COMBINER CIRCUIT

CATEGORY: Exploratory Development

DESCRIPTION: Efficient combiners with a 5% bandwidth and high power performance (1-50W) at millimeter wave frequencies. Concepts that simplify conventional combiners to increase reliability and reduce cost will be supported.

A85-034            TITLE: RESEARCH IN ARTIFICIAL INTELLIGENCE (AI) APPLIED TO ELECTRONIC WARFARE (EW) SYSTEMS

CATEGORY: Exploratory Development

DESCRIPTION: In the EW Mission, there are several application areas that appear as likely candidates for the use of AI techniques. Some of these include: ELINT System Management, Jammer Power Management, Threat Warning, Management of Unmanned Systems, Simulation, Maintenance, and Training. In each of these areas, there

is a significant need for human expertise in terms of background, experience, and judgment. The primary goal in the application of AI techniques to EW systems is to capture the knowledge of experts and replicate it for use by non-experts. AN extension of this goal is to replace the human operator, especially when logistic or hazardous considerations make replacement appropriate.

A85-035            TITLE: CO-CHANNEL INTERFERENCE REJECTION DIRECTION FINDING (DF) PROCESSING TECHNIQUES

CATEGORY: Exploratory Development

DESCRIPTION: The need exists for the development and demonstration of algorithms, techniques and processors capable of providing high resolution Electronic Support Measures (ESM) DF measurements against hostile radar threats operating in the presence of co-channel interference. These techniques must be capable of working against a mix of both broad spectrum, long pulse, and short pulse emitters.

A85-036            TITLE: AIRFRACT MULTI-SPECTRAL RADIO FREQUENCY (RF)/ELECTRO-OPTICAL (EO)/INFRARED (IR) CONTERMEASURES

CATEGORY: Exploratory Development

DESCRIPTION: Analysis needs to be performed to determine how to counter weapon systems that have integrated RF/EO/IR target acquisition and tracking systems. Successful jamming of these systems may require integrated Multi-Spectral Countermeasures.

A85-037            TITLE: STEERABLE NULL CONTROL TECHNIQUES

CATEGORY: Basic Research

DESCRIPTION: Investigation of control algorithms for steerable null antenna processors used in HF, VHF, and UHF communications. Emphasis should be placed on Least Mean Square (LMS) processing with multiplexed control of several control loops using a single processing circuit.

A85-038            TITLE: HIGH FREQUENCY ELECTROMAGNETIC SHIELDING EFFECTIVNESS OF SPECIALIZED CONDUCTIVE BOUNDARIES

CATEGORY: Basic Research

DESCRIPTION: The large part of currently available data on shielding effectiveness of conductive shields, braids, screens, and coatings is limited to frequencies below 100 MHz. The objective is to extend the electromagnetic shielding effectiveness data to an upper limit of 2 GHz. The nominal frequency range to be covered is 0.1 MHz to 2 GHz. Electrically conducting surfaces of interest are cable shields and braids, and optically transparent (to visible infrared) screens and coatings.

A85-039            TITLE: NEAR FIELDS OF SUBREFLECTOR IN CASSEGRAIN ANTENNAS

CATEGORY: Basic Research

DESCRIPTION: Develop reliable analytical/numerical techniques for accurately predicting the near field distribution in the vicinity of the sub reflector of a microwave cassegrain antenna system. The objective is to establish detailed knowledge of the power distributed in the immediate neighborhood of the sub reflector element.

This is to provide guidance towards development of methods to hold off breakdown and to reduce the influence of factors that contribute to loss of efficiency of the overall system.

A85-040            TITLE: BIASED TEM WAVEGUIDE ABSORPTION SECTION DESIGN AND FABRICATION

CATEGORY: Engineering Development

DESCRIPTION: Design and fabricate a biased coaxial ionized gas RF absorption measuring device to operate over a 100 MHz to 1 GHz frequency range. The device will be used in a system to measure RF absorption in an ionized gas as a function of the electric field between the inner and outer conductors of the coaxial wave guide section. Preliminary work will involve use of existing prototype design. Prototype design has been tested at ambient air pressure to date. Analysis and modification of prototype design is required to develop operations capability over 0.001 mmHg to 960 mmHg pressure range for a variety of gases, including air.

A number of devices corresponding to various coaxial impedances will be required, for example 25, 50, 100 and 200 ohms. Matched transition to 50 ohms must be incorporated in the design. Low atomic number material, such as aluminum must be used as much as possible to construction of the apparatus.

A85-041            TITLE: SOFT X-RAY MODIFICATION FOR AURORA

CATEGORY: Exploratory Development

DESCRIPTION: The HDL Aurora Radiation Test Facility produces intense high energy bremsstrahlung (10 Mev) that is used to simulate gamma radiation from nuclear weapons in developing radiation hardened electronics. Recently a proof-of-principle experiment confirmed an innovative analytic predication by Dr. Nino Pereira that the efficient high energy bremsstrahlung of Aurora could be converted to very intense soft x-rays of a type that could be used to test satellite systems in a way that could be as effective as those produced by dedicated soft x-ray simulators. This is significant, because these machines are expensive to build and additional test capability is required for satellite system testing.

The objective of this program would be to provide theoretical support, test planning, and hardware development support to assist in the development of a Soft X-ray Test Modification for the Aurora simulator. This development would lead to a useful soft x-ray test capability that would provide an environment of 20 Krads over 1000 a cm<sup>2</sup>test object.

A85-042            TITLE: LOW TEMPERATURE MERCURY-CADMIUM-TELLURIDE (HqCdTe) EPITAXY

CATEGORY: Basic Research

DESCRIPTION: One of the current efforts in the epitaxy of HqCdTe is organometallic vapor phase epitaxy (OMPVE). The technique involves the pyrolytic (thermal) dissociation of cadmium and tellurium alkyls in the presence of mercury vapor. The on-set of dissociation and deposition is dependent upon a minimum temperature, whereas the quality and composition of the ternary material is highly sensitive to temperature changes. Although the method appears to have the greatest potential as a production oriented technique for high-quality material; it is still linked to relatively high temperature requirement of approximately 400° C. At this temperature several things may occur that are undesirable: Unwanted diffusion between multilayers having different composition, thermal stress between layers, migration of dopants, formation of interfacial defects, etc. It would be highly desirable and a real improvement to be able to deposit HqCdTe at a much lower temperature.

Such low temperature epitaxy may be accomplished by the dissociation of the proper organometallics using high-energy radiation such as broadband UV lasers of proper output or even x-rays. Another possible method may

involve the use of specific catalysts in conjunction with a particular method of low temperature depositions from organometallics.

A85-043            TITLE: TUNABLE INFRARED LASER

CATEGORY: Basic Research

DESCRIPTION: An atmospheric transmission window exists in the 8 to 12 micrometer spectral range. Carbon dioxide lasers using various isotopes of CO<sub>2</sub> provide coherent radiation in this range of roughly 9 to 12 micrometers. Conversion efficiency of electrical excitation power to laser radiation output is typically in excess of 10 percent. It is desirable for a number of military applications to also have an efficient source of laser radiation in the 8 to 9 micrometers band and preferably one that is capable of providing tunable output over the complete 8 to 12 micrometers band. The purpose of this research effort is to explore techniques to provide such radiation. Indirect techniques such as Raman shifting and others are to be considered in addition to direct conversion. Desired output power is in the 1 to 10 watt range with efficiency of at least one percent is the initial goal.

A85-044            TITLE: NEW SUBSTRATE MATERIALS RESEARCH FOR IR DETECTORS

CATEGORY: Basic Research

DESCRIPTION: The overall objective of this program is to improve the scientific understanding, establish growth and purification techniques and to demonstrate the superiority of CdZnTe or CdMnTe as a material for substrates. Until recently epitaxial growth of HgCdTe has been restricted to the use of CdTe substrates. CdTe suffers as a substrate material in several aspects. The lattice mismatch is reasonably small in a percentage sense best effects. The superiority of CdZnTe and CdMnTe is based on the ability to provide an exact lattice matched substrate to minimize defect production and generation in epitaxially grown mercury cadmium telluride IR detector materials. Lattice matching substrates is a significant step in improving the quality of IR focal plane array. Currently, photovoltaic and photoconductive infrared detectors employing high performance HgCdTe focal plane arrays have performance limited materials problems. Of high significance are line defects, which prevail in the form of low angle boundaries and bulk defects caused by non-stoichiometry such as inclusions. Equally significant are point defects including vacancies, interstitial atoms, and impurity atoms. The pseudobinary CdTe-ZnTe and CdTe-MnTe system has little or no segregation in the region of interest resulting in homogeneous bulk grown material with a reduction in the bulk defects. The proposed research will make a significant improvement in the state-of-the-art of lattice matched substrate materials to be used for all future epitaxial HgCdTe growth programs.

A85-045            TITLE: MID-INFRARED LASER SOURCE

CATEGORY: Basic Research

DESCRIPTION: There is an atmospheric transmission window in the 3.5 to 4.1 micrometer spectral range that may be exploited for a variety of military applications requiring laser radiation. There is a need for compact, efficient, electrically excited lasers that operate in that band. The purpose of this program is to investigate novel techniques to provide both pulsed and continuous laser radiation with high efficiency in this spectral band. Both direct conversion and indirect conversion techniques such as Raman shifting shall be considered for this purpose. Pulse power of at least 100 kilowatts and continuous power of at least 1 watt is desired.

A85-046            TITLE: EW VULNERABILITY

CATEGORY: Basic Research – Advanced Development/Non-systems

DESCRIPTION: The US Army has an extensive program designed to stress its weapon systems to electronic warfare (EW) environments to establish their limits to hostile EW. This limit is called a system's EW vulnerability

and this vulnerability is reduced by the incorporation of electronic counter-measures (ECCM) into the system being developed to harden it to hostile EW. The EW environments consist of electronic countermeasures (ECM) and electronic support measures (ESM) that are used to direct, locate, and identify systems on a modern battlefield. The Army EW vulnerability assessment program requires advances in all three of these areas (ECCM, ECM, ESM). Further, these advances must be matched with advances in the use of electromagnetic spectrum which now encompasses radio frequency (RF), millimeter wave (mmw), infrared (ir), optical (O), and ultraviolet (UV) portions of the spectrum. The use of three or more of these regions is defined as multispectral and, because of the costs required to conduct EW vulnerability assessments, all advances are to be oriented to as broad banded or multispectral frequency coverage as possible.

A very broad base of scientific knowledge exists regarding magnetic fields but, because of the short range and low field densities, magnetic fields have found small application in Army ESM techniques. Thus, we need to develop magnetic field applications that can be used to complement existing ESM techniques across the spectrum. Multispectral sensor concepts need to be developed to permit simultaneous measurements of military systems to establish system signatures over the measured spectrum. Multispectral radomes (20' x 34" x 40") capable of permitting measurements simultaneously across RF, mmw, ir, O, and UV frequencies in a KC-135 aircraft environment are required for air-to-air and air-to-ground measurements.

Two major areas of ECM advancement are required. These are advanced chaff and smart munitions ECM techniques. Advanced chaff techniques are required for multispectral ECM environments. The chaff techniques proposed should consider the type of material, form, and development technique. The smart munitions ECM techniques must be as broad banded (multispectral preferred) as possible to minimize the costs in applying them to a wide variety of munitions currently undergoing development.

The ECM advances required are for electro-optical (EO) devices. These ECCM techniques should be used to reduce effects of lasers used as ECM against the EO devices. Emphases should be placed on ir, television, night sight, and UV systems.

A85-047            TITLE: INTELLIGENT SENSOR RESOURCE MANAGEMENT

CATEGORY: Basic Research

DESCRIPTION: Assume the existence of an Army tactical situation (e.g. Blue vs. Red). Further assume the existence of an arbitrary set of Blue Army intelligence sensor resources which include, but are not limited to, the following types: SIGINT, IMINT, and HUMINT. Assume that this set of sensors is configured non-optimally and deployed to perform some information/data gathering function in support of the Blue Army intelligence production requirements.

In addition, assume that the intelligence process is automated and results in the generation of a set of probable Red Army OB (order of battle) hypotheses. This situation assessment paradigm is assumed to be generating its threat OB. Information processed includes available intelligence sensor data, which has been distilled and preprocessed by Army intelligence analysts; battlefield terrain information and weather conditions; equipment logistic requirements; potential equipment synergism; a knowledge of Red Army doctrine; special domain features such as roads and bridges, and numerous other factors. The melding of this information provides an assessment of the enemy OB in a process called intelligence fusion. The major source of information indicating enemy intent is provided by the set of intelligence sensors available to and managed by the intelligence staff officer (G2).

A set of intelligence sensors can be used by the G2 in two ways: 1) to gather intelligence information, and 2) to validate or disprove hypotheses currently developed by the intelligence fusion process. A resourceful G2 is able to manage his sensor resources in such a manner as to optimize the potential of gathering useful intelligence information while simultaneously validating or disproving currently developed OB hypotheses considered important and crucial to the outcome of the tactical engagement. This type of resource management is clearly dynamic since resources may be deployed and committed to an objective only to have additional criteria develop which may alter the sensor mission objectives prior to the completion of existing mission objectives. In addition, mission management clearly requires that the mission manager be aware of the effects of the tactical domain (e.g. weather,

terrain, vulnerability, hear ability) upon each sensor and its ability to perform optimally as a single unit and must be aware of Red Army doctrinal considerations and possible logistic constraints when considering a choice of possible sensors for a mission; these considerations may profoundly alter the choice of type of sensor(s) deployed since doctrine and logistics may suggest possible Red Army deployment and usage of equipment.

#### Proposed SBIR Research:

The above discussion strongly suggests that the effective and timely management of sensor resources by the G2 is not a deterministic and well-understood process, but requires imagination and human-like intelligence. It is therefore proposed that basic research be directed towards the development of an Artificial Intelligence based paradigm which would be capable of providing Intelligent Sensor Resource Management given an arbitrary set of sensor resources, and arbitrary tactical domain in which the tactical scenario takes place, and a set of G2 (or an automated G2 process) developed OB hypotheses. Emphasis should be given to the development of a robust, artificial intelligence based, non-statistical paradigm, which is truly domain independent. In addition, the paradigm must be capable of providing the human user with justification for its mission management recommendations together with the development of timely reports, which can be used by the G2, to rank order/alter/develop OB hypotheses. Finally, a limited-domain test implementation of this paradigm should be provided together with a proof of extensibility to actually tactical domains.

#### A85-048 TITLE: INTEGRATED POWER CIRCUITS

##### CATEGORY: Exploratory Development

DESCRIPTION: Jammer amplifier and transmitter circuits need to be lighter and cheaper. Integrated circuit technology has made low power analog and digital circuits extremely cheap. It is desired to perform similar integration on power circuits; handling 100-400 W output power per basic power module. These power modules would be in the HF and VHF bands, e.g. 1-100 MHz, 80-400 MHz. The basic power modules would be used alone or in assemblies to make up a large transmitter. The use of integrated circuit concepts should increase reliability and decrease costs. The circuit substrate could be used for a cooling surface and the circuit could be designed mechanically to have modular, self-aligning cooling passages for liquid or air-cooling when assembled in large transmitters.

#### A85-049 TITLE: HF JAMMING ANTENNA FOR HELIBORNE SYSTEMS

##### CATEGORY: Exploratory Development

DESCRIPTION: Pursue improvements in HF antenna systems for use on various helicopter platforms. Antenna applications will include communication and direction finding in the HF range. Due to space constraints, particular emphasis should be directed toward miniaturization and weight reduction, direction ability and gain for jamming applications.

#### A85-050 TITLE: OWN JAMMING EXCISION

##### CATEGORY: Exploratory Development

DESCRIPTION: In some current jammers it is not possible to track a signal or search for another one while jamming is being conducted. The man kilowatt ERP is dangerous to the microvolt sensitive receiver and large filters do not work because the receiver is desensitized to the point of not being functional. The current technique is to simply turn the receiver off via an isolation switch on the input. This, however, limits the jamming system in its speed of response to acquiring or reacquiring a signal. A means is needed of eliminating one's own jamming signal from the receiver and simultaneously allowing the receiver to stay on to capture the threat signal. The means of excision must not be exploitable by the enemy so that he would use the technique to eliminate our jammer. The technique must be able to handle several kilowatts ERP from the jammer yet allow a receiver with several microvolt



sensitivity to operate satisfactorily. The receiver and jammer usually share the same antenna, which may be a reasonably frequency-independent design, such as a log periodic.

A85-051            TITLE: COMBINERS

CATEGORY: Exploratory Development

DESCRIPTION: Broadband high power handling but physically small combiners are required for HF/VHF jammers. The combiner needs to cover the continuous HF/VHF band as much as possible and handle from hundreds of watts to several kilowatts of input power. Conventional transmitters are made up on many basic power modules in parallel adding their power through combines to achieve high power outputs. The losses of present combiners require excessive numbers of power modules for power offset; the bandwidth of present combiners restrict multi-octave system design perhaps unnecessarily.

A85-052            TITLE: POWER/FREQUENCY ADAPTIVE AMPLIFIERS AND TRANSMITTERS

CATEGORY: Exploratory Development

DESCRIPTION: Present jamming systems are broadband, e.g. 10-80 MHz to handle a variety of threats. Extension of this bandwidth capability to handle the entire HF/VHF, 3-300 MHz, is a very desirable but an extremely difficult design problem to handle power efficiently and to minimize spurious outputs, harmonics, efficiently couple to antenna, etc. In many military problems the presented threat may only occupy a portion of jammer's bandwidth, hence the system is in a sense over designed. It is desired that the jamming system be able to automatically reshape its output frequency response to match a given threat. The system should also be able to change its class of operation, e.g. from Class A to Class B, when it might be allowable to produce more harmonics in order to produce more power vs. a given threat. This reconfiguration capability should be executable in seconds under software/firmware control, i.e. under an artificially intelligent system controller. When the system reconfigures itself relatively slowly, it should retain a reasonably instantaneous bandwidth. In the case of, for example, 3-300 MHz range, the instantaneous bandwidth could be 3-10 MHz one time, 30-80 MHz the next, so that in any dense RF sub band, instantaneous jamming response would be available. A benefit of this approach to transmitter design is that one variable 3-300 MHz jammer could replace several narrow band jammers. Hence, logistics costs can be significantly reduced.

A85-053            TITLE: MULTI-HOLLOW COMPOSITE SHELL BRIDGE DECK

CATEGORY: Exploratory Development

DESCRIPTION: Deck is to be a low density, tough composite material that is reinforced with high strength to weight fiber (graphite, Kevlar). The material will be formed into a cylindrical shell with pinned ends to form a segment of a circular arch. The surface of the material will be in direct contact with tire and tank treads and is required to sustain high loads under very aggressive conditions.

A85-054            TITLE: REGENERATIVE SULFUR SCRUBBER

CATEGORY: Exploratory Development

DESCRIPTION: Processing of liquid hydrocarbon fuels containing sulfur to generate a dirty hydrogen gas stream has been demonstrated. Secondary processing of the stream is required to enrich hydrogen and reduce carbon monoxide content before it is suitable for use in a phosphoric acid fuel cell. A compact regenerative scrubber capable of continuous removal of sulfur compounds is desired to prevent poisoning of secondary processing catalysts.

A85-055            TITLE: GASEOUS CARBON DIOXIDE, HYDROGEN, OR WATER VAPOR SEPARATOR

CATEGORY: Exploratory Development

DESCRIPTION: Generation of hydrogen streams from hydrocarbon fuels suitable for use with a phosphoric acid fuel cell could be enhanced if:

- a. Carbon dioxide could be removed from the hydrogen stream;
- b. Water vapor could be separated and utilized in the fuel processor; or
- c. Hydrogen could be separated for direct feed into the fuel cell.

To be attractive, a device to accomplish any of the above should be capable of continuous operation at temperatures approximating fuel processor temperatures.

A85-056            TITLE: SMALL THERMAL STORAGE DEVICE

CATEGORY: Exploratory Development

DESCRIPTION: Study and develop a cold heat sink (thermal storage) for combat vehicle environmental control during silent watch operation. Device would require negligible power to operate.

A85-057            TITLE: REVERSE OSMOSIS MEMBRANE ELEMENT CLEANING

CATEGORY: Exploratory Development

DESCRIPTION: Investigate the feasibility of using alternative improved procedures for the cleaning of fouled spiral-wound reverse osmosis membrane elements used in Army reverse osmosis water purification units. There is evidence that current cleaning procedures employing citric acid and Triton X have an adverse effect on the performance of these elements. The objectives of this investigation are to determine the cause of this degradative effect and to develop an improved simple, effective, field procedure for cleaning these membrane elements, which are currently being procured from three manufacturers who supply three chemically different membranes.

A85-058            TITLE: FIELD METHOD OF MONITORING WATER SUPPLIES FOR RADIOACTIVITY.

CATEGORY: Exploratory Development

DESCRIPTION: Establish the feasibility of determining the concentration of radioactivity in water at the Army MPC (Maximum Permissible Concentration) level of 1000 picocuries per liter of mixed fission products in the field. The method must be practical for use under battlefield conditions, i.e., the equipment must be simple, rugged, lightweight, of low cubage, and operable in a radiation field in the order of 100 milliroentgens per hour.

A85-059            TITLE: PIPELINE CORROSION AND FRICTION REDUCTION COATINGS

CATEGORY: Exploratory Development

DESCRIPTION: Investigate the feasibility of coating military pipelines for corrosion protection and internal friction reduction. The investigation would identify the available coating material(s), the most effective coating material and the most cost-effective material.

A85-060            TITLE: FOLDING WING MECHANISM

CATEGORY: Exploratory Development

DESCRIPTION: A need exists to develop mechanisms which permit large wings to be deployed from a missile after being launched from a tube or canister. The mechanism must permit long term storage of the missile in the tube or canister, and the mechanism must provide for deployment of cruciform wings which have planform areas that are about one-fourth to one-half the body planform area for each panel. The aspect ratio (exposed span/average chord) for each wing panel will be from two to four, with taper ratios (tip chord/root chord) from 0.25 to 1.0. In the deployed position, the wings must be rigid, accurately aligned and aerodynamically smooth and efficient.

A85-061            TITLE: ANALYSIS OF IMPACT OF MISSILE CROSSING VELOCITY ON SHAPED CHARGE PENETRATION PERFORMANCE

CATEGORY: Exploratory Development

DESCRIPTION: A need exists to analytically estimate the degradation of shaped charge penetration performance into conventional and advanced armor caused by the misalignment of the missile velocity vector and the shaped charge jet velocity vector. Such misalignment occurs when the warhead is fixed at some angle relative to the longitudinal axis of the missile or when the missile flies at some angle of attack relative to the missile velocity vector. Under certain conditions, an intentional misalignment promises increased warhead lethality, but before such a design can be optimized, it is essential to be able to estimate the penetration degradation when such variables as missile velocity, alignment angle, and shaped charge jet characteristics are varied. Proposals addressing this need can be applied to efforts in antitank-guided munitions and should be classified secret.

A85-062            TITLE:     INERTIAL        INSTRUMENT/SYSTEM     INITIALIZATION/CALIBRATION TECHNOLOGY

CATEGORY: Exploratory Development

DESCRIPTION: There is a critical need for a means to calibrate low cost inertial (LCI) systems installed in a missile. LCI instruments, having a potential for midcourse missile guidance mechanizations do not need long term stability but they do need good day-to-day repeatability. An internal initialization/calibration scheme would reduce the overall cost of ownership while maintaining the performance of inertial instruments/systems since they would be calibrated immediately prior to use. This task will address more effective ways of implementing various initialization/calibration techniques thorough the use of algorithms, computers, and theoretical analyses.

A85-063            TITLE: DYNAMIC BORESIGHT MENSURATION

CATEGORY: Exploratory Development

DESCRIPTION: A means is required to measure in real-time the bore sight error and aim point between a missile or rocket and the sighting or reference system. Once the capability to measure these errors (three axis system) is achieved, the true aim point can be established. It is preferred that the measurement technique be neither mechanical nor the comparison of separate inertial references. Currently, techniques are available to measure these errors for two axis but not three, as required. These systems use low power, narrow beam lasers, optics, and sensor arrays and are in use in Directed Energy programs. The approaches should consider a high vibration environment, no mechanical or electrical linkage between measurement points, night and day operations, no visible signature, operator safety, data rates and achievable accuracy versus cost. Results would include a brass board demonstration along with supporting analyses.

Applications include hypervelocity rockets on helicopters, the reference system between the mast mounted sight and the inertial reference system on the Army Helicopter Improvement Program, multiple round artillery rocket systems, and the sighting and laying of LANCE and PERSHING.

A85-064            TITLE: CORRELATION OF ULTRASONIC MEASUREMENTS WITH PROPELLANT MECHANICAL PROPERTIES AND IN-SITU PREDICTION OF PROPELLANT SERVICE LIFE

CATEGORY: Exploratory Development

DESCRIPTION: There is a need for the development of a mathematical model to relate ultrasonic time and frequency domain data, obtained from solid propellant samples, to parameters such as the complex loss modulus and the complex storage modulus. Computer codes should be developed to calculate and display these results using a digital computer. Also, there is a need to develop technology to non-destructively determine, in-situ, and the mechanical properties of solid rocket motor propellant. This information is necessary to predict the service life of fielded missile systems.

A85-065            TITLE: SYNTHESIS OF UNIQUE ENERGETIC POLYMERS AND OXIDIZERS

CATEGORY: Basic Research

DESCRIPTION: Synthesis of energetic polymers is desired that have special unzipping linkages (e.g., azo linkage) or linkages with strained ring molecules in the backbone that can be catalyzed to break or rearrange with energy release. The polymers must not contain the elements chlorine or sulfur and must have minimal metallic atoms. High oxygen content is desired. These polymer characteristics are believed to possess properties which will lead to higher burning rate minimum smoke propellants. The effort is to synthesize and characterize the polymers and evaluate compatibility with existing propellant ingredients. Advanced oxidizers containing energetic groups such as azidodinitromethyl, cyanodinitromethyl or trinitromethyl groups are of interest. The compounds of interest will have higher density and higher oxygen content than those of current minimum smoke propellant oxidizers. This effort will include characterization and compatibility testing of candidate oxidizers.

A85-066            TITLE: HIGH DIELECTRIC STRENGTH MATERIALS FOR SHORT-PULSE ELECTRICAL STRESS

CATEGORY: Basic Research

DESCRIPTION: Solid dielectric materials and processes are needed which will exhibit extremely high resistance to rupture under conditions of short, fast-rising voltage pulses. The electric field stresses withstood should be in excess of 16 mega volts per centimeter at a material thickness of several centimeters. The electrical stress would be a single polarity rising from zero volts to maximum in one nanosecond or less and remaining high for a few tens of nanoseconds. These materials and processes must be capable of being used for practical engineering and construction of high voltage pulse systems.

A85-067            TITLE: ROBOTIC VEHICLE ENHANCEMENTS

CATEGORY: Exploratory Development

DESCRIPTION: In two to three years the Robotic Vehicle Demonstrator (RVD) will demonstrate advanced remote control/teleoperation techniques in Army User field tests. Advanced techniques in digital terrain analysis, route and path planning, internal and external land navigation stereo vision and other sensor systems will be evaluated. This program is a first step towards the demonstration of a semi-autonomous vehicle desired by the Armor Center under its operational concept "Modular Autonomous Robotic System (MARS)".

In order to accomplish semi-autonomous operation advances in the above techniques plus improvements in machine vision, artificial intelligence, image interpretation and processor control systems are required.

A85-068            TITLE: DEVELOPMENT OF A DUST DETECTOR TO PROTECT ENGINES OF COMBAT AND TACTICAL VEHICLES

CATEGORY: Exploratory Development

DESCRIPTION: Failure of air cleaner systems is a major cause of engine failure. TACOM is currently investigating various methods of detection and alarm when particles are entering the engine. Methods include acoustical, electrostatic, light scattering and laser defraction. It is not clear what approach is optimum or whether investigations to date have been comprehensive. Requirements exist for inexpensive sensors with simple warning to the operator and for more elaborate systems which provide data with prognostic potential. Examples of this data would be particle size distribution, velocity at critical wear points and total ingested mass.

A85-069            TITLE: QUICK DISCONNECT COOLANT HOSE

CATEGORY: Exploratory Development

DESCRIPTION: A major cause of engine failure in combat vehicles is loss of coolant, resulting in engine overheating. Cooling systems consist of a myriad of hoses connecting radiator(s), expansion tanks, engine and auxiliary coolers. Silicon or rubber hoses are connected to aluminum or steel fittings with heavy-duty automotive screw actuated clamps. Connections may be "blind", causing incorrect installation; hoses deteriorate and harden, clamps fail, resulting in loss of the engine.

A solution is envisioned which would have similarity to hydraulic oil quick disconnects. Quick and positive connection and disconnect, combined with positive sealing and protection against massive contamination will provide protection against maintenance induced failures as well as ease of maintenance under field conditions.

A85-070            TITLE: CORROSION

CATEGORY: Exploratory Development

DESCRIPTION: Corrosion is a problem that adversely affects the operational readiness of the Army's Tactical Wheel Vehicle Fleet, particularly in areas such as Hawaii, Panama, Michigan, Florida, etc. The need exists for a computerized data base to monitor this damage and, additionally, to reflect what efforts have been made to repair rust damage, indicating rate of repair, as well as efforts that have been made to retard rust damage such as thru conventional rust proofing. The data base would be expected to identify the vehicle, its location, and the nature of the rust damage; for example, stage 1, 2, 3, 4, with stage 1 being superficial surface corrosion and stage 4 being the most advanced, including perforation and loss of strength. Cost estimates to repair the damage would also be included.

A85-071            TITLE: DIFFERENTIAL PRESSURE TRANSDUCER WITH VARIABLE ANALOG OUTPUT FOR USE WITH DCAS

CATEGORY: Exploratory Development

DESCRIPTION: The three-set-point differential pressure switches currently used with vehicle Diagnostic Connector Assemblies (DCAs) are only a low cost approximation to analog output differential pressure transducers. They provide little information about the actual conditions they are measuring, i.e., across a filter element. The analog output differential pressure transducer would give an indication of actual conditions at the filter under all conditions. It is necessary, therefore, to design a semiconductor type analog differential pressure transducer that can be used with new vehicle DCA Designs and Simplified Test Equipment.

A85-072            TITLE: VEHICLE WASTE DISPOSAL SYSTEM

CATEGORY: Exploratory Development

DESCRIPTION: Develop a system for disposal of waste materials from interior of the vehicle, e.g., human waste, chemical agent decontamination material and other contaminated material. A system is needed to allow disposal of waste materials generated inside the vehicle while operating in an NBC contaminated environment without disposing to the outside of the vehicle. At present, it is a general practice to toss these waste materials out of the vehicle through a vehicle hatch. This practice will not be practical under closed hatch (buttoned-up) condition.

A85-073            TITLE: VEHICLE INTERIOR CONTAMINATION AVOIDANCE SYSTEM

CATEGORY: Exploratory Development

DESCRIPTION: Study different contamination avoidance system concepts for combat vehicles to protect vehicle interior while the crew enters the vehicle in a contaminated battlefield environment. Combat vehicles, such as M1 Tank and M2/M3 Bradley Fighting Vehicles, will have hard times keeping the interior of the vehicle clean (free of chemical contamination) under different fighting scenarios. A protective entrance for contamination avoidance is needed to reduce degradation in combat effectiveness. Otherwise, while entering from contaminated battlefield, crewmen will bring contamination into the vehicle.

A85-074            TITLE: LONG LIFE TRACKS

CATEGORY: Exploratory Development

DESCRIPTION: This program is to develop new track design and manufacturing technology reversing the usual/classical approach of contracting to tire/rubber companies. The aim would be to resort to designers and manufacturers of heavy duty conveyors to research and resolve the short life dilemma associated with tracks. The emphasis of effort would be directed towards a long life metal track with a secondary consideration for track pads reversing the present approach.

A85-075            TITLE: ROADWHEELS

CATEGORY: Exploratory Development

DESCRIPTION: This would involve new design and manufacturing approaches to provide a road wheel with longer life and greater ease of repair and maintenance by the field troops. Consideration would be given to "press-on" rubberized rims that would press-fit upon metal wheels.

A85-076            TITLE: LIGHTWEIGHT MATERIALS AND MATERIAL SYSTEMS WITH IMPROVED ARMOR CAPABILITY

CATEGORY: Exploratory Development

DESCRIPTION: Primary threats to structured armor systems include small, medium, and large-caliber high-density bullets as well as chemical energy warheads. These threats have shown a steady growth in lethality such that protection with conventional armor requires prohibitively high weights. New materials concepts are needed incorporating a capability of defeating selective munitions, surviving multiple hits, yet retaining structural capability at the lowest possible weight.

A85-077            TITLE: HARD COATINGS FOR OPTICAL SYSTEMS

CATEGORY: Exploratory Development

DESCRIPTION: Broadband sensors require hard, erosion-resistant coatings, which are transparent from ultraviolet, through the visible, well into the infrared radiation wavelengths. New concepts for such coatings compatible with state-of-the-art optical materials are desired. Such concepts should also address the practicality of operating reliably and reproducibly in a production mode.

A85-078            TITLE: IMPROVED PERFORMANCE IN RESIN MATRIX COMPOSITES

CATEGORY: Exploratory Development

DESCRIPTION: Innovative approaches are necessary to improve the performance of resin matrix composites. Areas which are being considered for study are:

- a. Development of resin matrices exhibiting minimal or zero shrinkage during cure. Minimal shrinkage being less than ½ percent when cured at 177 C (350°F). Approaches such as the incorporation of spiro compounds into epoxy matrices will be considered. The resins should also exhibit mechanical and physical properties suitable for use in structural composites.
- b. The mechanical properties of resin matrix composites produced by wet laminating techniques such as filament winding and pultrusion are often degraded by void formation. A method to eliminate or reduce the formation of voids due to entrapped air is required. Innovative approaches compatible with the wet laminating processes are being sought and would be considered under this topic.
- c. A rapid non-destructive method for determining the resin/fiber content of fiberglass and/or aramid fiber composites is required. Current methods such as those approved by ASTM are time-consuming and require destruction of the sample. The proposed technique(s) should be applicable for fiber-reinforced composites up to 1" thick and 60 fiber volume percent.
- d. Manufacturing techniques for producing ambient-temperature, rapid-cure (2-4 hours) repair kit resins including prepregs with chemical and physical properties approaching those of 350°F cure high-performance epoxies would also be applicable under this topic.

A85-079            TITLE: COMPOSITE SPECIMEN DESIGN ANALYSIS

CATEGORY: Exploratory Development

DESCRIPTION: One of the current problems associated with the mechanical testing of organic matrix composite materials is the inconsistency of the test data. A thorough analysis of specimen design would allow optimization of the configuration and eliminate specimen design as a contributor to inconsistent test results.

A85-080            TITLE: NONDESTRUCTIVE EVALUATION TECHNIQUE

CATEGORY: Exploratory Development

DESCRIPTION: An effort is needed for the nondestructive evaluation of ceramic materials. Requirement is to detect critical flaws in the 20 to 50 micrometer range. Technique must be able to scan or to inspect at least 6" square billets of material and allow evaluation of defects in the body of the material.

A85-081            TITLE: ROBOTICS

CATEGORY: Exploratory Development

DESCRIPTION: Robotics is the topic of significant activity within the Department of the Army and AMC. Results of 3 years of effort in this technical area have led to an emphasis on combat service support/material handling issues as areas of maximum near-term leverage for robotics. The specific areas of technical interest include soldier-machine interface in the robotics context, e.g. new approaches to programming general purpose robotic materials handling/logistics equipment, field oriented safety systems which would permit soldiers to safely function within an operating robots work envelope. Robotics is currently funded under exploratory development (6.2) and is included in the Soldier-Machine Interface "new thrust" program initiative.

A85-082            TITLE: PORTABLE DEVICE FOR DETERMINING SORPTION OF CHEMICAL PROTECTIVE GARMENT MATERIALS IN THE FIELD

CATEGORY: Exploratory Development

DESCRIPTION: A device is needed for testing chemically protective over garments in the field. The device should either correlate with the standard carbon tetrachloride and/or agent penetration devices presently used to determine the sorbtivity of a garment or be actually a miniaturization of such a device. The test device shall use one or more appropriate procedures similar to those cited in MIL-C-4358A, or EATM 311-3 Laboratory Methods for Evaluating the Protection of Permeable Protective Clothing Against Chemical Agents, by Dawson and Gilchrist, 1967.

A85-083            TITLE: TEST METHODOLOGY AND APPARATUS FOR MEASUREMENT OF STATIC ELECTRICITY IN FABRICS

CATEGORY: Exploratory Development

DESCRIPTION: There is concern over the propensity for static charging in Combat Vehicle Crewmen and aircrew uniforms made from polyaramid fibers. A stainless steel/polyaramid fiber blend is being considered to alleviate this problem.

The overall effort would require development of an effective test plan leading to correlation of percent stainless steel fiber content to the buildup and dissipation of static charges under varying conditions of temperature and humidity. An appropriate test apparatus for this purpose must also be developed or adapted from existing equipment.

A85-084            TITLE: STEAM GENERATOR

CATEGORY: Exploratory Development

DESCRIPTION: Develop a field steam generator, adaptable to military Field Food preparation systems and capable of using any untreated water. The unit should be easily cleaned and have a self-cleaning feature. The generator would provide the central energy source for a Field Food Service.

A85-085            TITLE: DESIGN OF A HEAT SEALING MACHINE TO HERMETICALL SEAL FLANGELESS POLYMERIC CONTAINERS

CATEGORY: Exploratory Development

DESCRIPTION: The protecting rim or collar of a container is called a flange. The flange provides an easy means of sealing polymeric containers. The flange, however, requires space within a shipping container and is vulnerable to damage during shipment and handling.

Fabrication of a flangeless container is no problem. This effort is to develop a sealing device that will hermetically seal a flangeless container. A laboratory unit will be required for experimental studies and the design should be such that scale-up to production speed equipment could be built.



A85-086            TITLE: REFINEMENT OF CARTOGRAPHIC FEATURES IN AUTOMATED MAPPING SYSTEMS

CATEGORY: Exploratory Development

DESCRIPTION: Perform investigations on the use of graph theory as a means to organize the preliminary cartographic information obtained from automated mapping systems in a manner that cooperative and concurrent control of several processors will improve individual processor output and provide synthesized information from the several processors.

Current automated cartographic systems employing threshold methods lost track when following road or stream features in the cluttered environment of digital aerial photography; techniques are required to overcome this problem if automated cartographic systems are to be fully effective.

A85-087            TITLE: SMALL RODENT CYANIDE PRETREATMENT/THERAPEUTIC TEST SYSTEM

CATEGORY: Exploratory Development

DESCRIPTION: A small rodent mortality test system to quantify the antidotal activity of a candidate new drugs against cyanide challenge is required. Studies will involve such effects as prophylactic and/or therapeutic administration of compounds, acute LD 50 data, duration of effects, optimal times of administration, and therapeutic ratios.

A85-088            TITLE: PHYSIOLOGIC STABILIZATION AFTER TRAUMA

CATEGORY: Basic Research

DESCRIPTION: A general requirement exists to provide improved field care after traumatic injury when evacuation is delayed. The overall aim of this research and development is to provide treatment under adverse conditions that maximized salvage ability and recovery once definitive care becomes available. Contemplated efforts cover a wide technological spectrum from state-of-the-art applications designed to improve and simplify first aid and resuscitative methods in the field to basic scientific investigations designed to explore unusual and innovative technical means for temporarily suspending or stabilizing pathophysiologic processes after traumatic injury.

A85-089            TITLE: BLOOD BAGS

CATEGORY: Advanced Development/Non-Systems

DESCRIPTION: A requirement exists to develop rugged, plastic bags that can be stored with a preservative for ten years. The bags must be tolerant to wide temperature fluctuations with in a 24-hour period.

A85-090            TITLE: BLOOD PRESERVATIVES

CATEGORY: Basic Research

DESCRIPTION: A requirement exists to develop a new blood preservative that allows red cells to be stored up to 56 days while maintaining at least 80 percent of their original 2, 3 diphosphoglycerate.

A85-091            TITLE: BLOOD SUBSTITUE

CATEGORY: Basic Research

DESCRIPTION: A requirement exists for a safe, efficacious emergency blood substitute for human use when whole blood is unavailable. Any proposed substitute should provide acceptable volume expansion as well as tissue oxygenation delivery capacity without requiring oxygen enriched breathing mixtures. Prolonged room temperature storage of the dehydrated material is desirable for logistic purposes.

A85-092            TITLE: LYOPHILIZED PROTEIN IN PLASTIC BAGS

CATEGORY: Basic Research

DESCRIPTION: A requirement exists to develop a technique to fill sterile plastic bags with a sterile protein solution follow by pyophilization of the protein for long-term storage.

A85-093            TITLE: PROTECTION OF MEDICAL EQUIPMENT AGAINST ELECTROMAGNETIC PULSE

CATEGORY: Engineering Development

DESCRIPTION: There is a need to protect current a projected equipment against burnout or alteration of electrical activity of components due to high altitude nuclear detonations. Such EMP effects may produce failure of life sustaining medical equipment as respirators, EKG and EEG apparatus, anesthesia machines, and laboratory measuring equipment. Simple, inexpensive solutions to protect power supplies and electronic circuits against burnout are required.

A85-094            TITLE: OPERATOR STATUS AND FUNCTIONAL CAPABILITY ASSESSMENT

CATEGORY: Exploratory Development

DESCRIPTION: Recently developed enhanced technology systems, such as the AH-64 advanced attack helicopter and the M-1 Abrams main battle tank, are multimillion dollar systems carrying sophisticated, state-of-the-art weaponry and instrumentation. Modern tactical scenarios, such as CBR contamination, enhanced radiation weapons, or directed energy weapons could disable the operating personnel of these systems without appreciable damage to the system itself. Functional systems, treatable personnel, and intelligence information could be unnecessarily lost to enemy forces.

What is desired is an automated system that can monitor and assess the operator's functional status. This includes both biomedical (physiological) and behavioral status monitoring and evaluation. The system must have the intelligent capability of integrating the biomedical, behavioral, and vehicular parameter inputs and determining when the operator has become functionally capable of continuing or completing the mission. The output of this assessment would be used as evidence for transferring control of the vehicle to an automatic guidance and control system.

A85-095            TITLE: ENVIRONMENTAL HEAT STRESS WEATHER NETWORK

CATEGORY: Exploratory Development

DESCRIPTION: There is a need to study the feasibility of implementing a standardized wet-globe temperature (WGBT) index data acquisition and retrieval network to support comprehensive computerized environment intelligence resource for military operations conducted at specific sites, worldwide. Because of technological advancements in many aspects of military operations, the soldier's ability to function effectively has emerged as a critical "weak link" in the planning of military operations conducted in hot environments. The system would

provide reliable projections of physiological impact on the soldier and associated tactical limitations and logistical requirements.

A85-096            TITLE: RESEARCH IN EYE PROTECTION

CATEGORY: Basic Research

DESCRIPTION: Basic Research in innovative approaches to the protection of the eye against high intensity light sources, including laser irradiation, are required. Exposure durations of light flashes may be in the picoseconds to milliseconds timeframes, with the possibility of repeated exposures. Wavelengths of interest for protection include the visible spectrum (400-700nm) and near infrared (700-1200nm). An otherwise completely transparent material, unless irradiated, is desirable as an end goal. Special emphasis should be directed toward the ultra short exposure durations. Only preprototype test systems will be required.

A85-097            TITLE: SUBUNIT VACCINES FOR MILITARY-IMPORTANT DISEASES

CATEGORY: Exploratory Development – Advanced Development/Non-systems

DESCRIPTION: Subunit vaccines are those composed of key portions of killed microorganisms. The aim of this effort is to rid the killed microorganism of undesirable components by utilizing the techniques of microbial engineering and identifying just those parts of an organism that are able to produce immunity without side effects and to utilize genetic engineering to produce these purified antigens in large quantities.

A85-098            TITLE: DIAGNOSIS OF NATURAL AND INDUCED DISEASES OF MILITARY IMPORTANCE

CATEGORY: Exploratory Development – Advanced Development/Non-systems

DESCRIPTION: This effort is designed to provide state-of-the-art technology to develop a system for rapid identification and diagnosis of agents or diseases acquired naturally or by exposure to biological weapons. The system will provide for rapid identification of agents/diseases through examination of clinical specimens such as blood, urine, spinal fluid, and throat washings. The system should be extremely sensitive using very specific reagents such as monoclonal antibodies prepared through hybridoma technology.

Methods utilizing the latest in biotechnology techniques should be utilized, such as labeled molecular probes for the identification and analysis of microbes or their products.

A85-099            TITLE: PRODUCTION OF MAMMALIAN METABOLITES OF TRICHOTHECENE MYCOTOXINS

CATEGORY: Advanced Development/Non-systems

DESCRIPTION: Specific metabolites of the trichothecene toxins that are produced in whole animals are needed in sufficient quantity to use as standards for analytic procedures and for toxicity testing. Multimilligram quantities would be required. The metabolites of T-2, DAS, and nivalenol are of principal interest.

A85-100            TITLE: IMMUNOASSAY FOR T-2 TETRAOL

CATEGORY: Exploratory Development

DESCRIPTION: T-2 tetraol is a principal urinary metabolite of T-2 in mammalian systems. An assay effective in sensitivity measuring T-2 tetraol in urine is needed to screen for prior exposure to T-2. Production of a sensitive immunoassay is desired.

A85-101            TITLE: VACCINE DELIVERY SYSTEMS

CATEGORY: Exploratory Development

DESCRIPTION: A requirement exists for controlled-release systems, carriers, and/or adjuvants compatible with vaccines or subunit vaccines for high-hazard agents of specific interest to the Army. Additionally, a need also exists for new methods of immunization and/or mucosal immunity to these high-hazard agents.

A85-102            TITLE: FALCIPARUM MALARIA FIELD ASSAY KIT

CATEGORY: Advanced Development/Non-systems

DESCRIPTION: Require development of a field kit composed of materials and instructions for conduct of a standardized enzyme-linked immunosorbent assay to detect falciparum malaria sporozoites. The kit should employ reagents that are currently available and test procedures/materials must be compatible with test systems currently under development by the Army. This work will require extensive testing to standardize test methods, reagents and results in terms of sensitivity and specificity.

A85-103            TITLE: RESEARCH IN LEADERSHIP DEVELOPMENT

CATEGORY: Exploratory Development

DESCRIPTION: Research support is required for a comprehensive progressive sequential leader development program from the perspective of the total Army system. Of particular interest are: decision making and decision support systems; cognitive skills assessment and development; the relations between leadership, unit/organizational effectiveness, and productivity; and senior leadership requirements.

A85-104            TITLE: RESEARCH IN DEVELOPING OPTIMUM METHODS FOR MEASURING JOB PERFORMANCE

CATEGORY: Exploratory Development

DESCRIPTION: The Army is designing a total selection and classification system that involves predictor measures (to help select the right people and place them in appropriate jobs) and performance measures (to tell us how well the soldiers perform after joining the Army). Four types of performance measures are of great importance to the Army: 1. training measures, i.e., measures of progress in the training situation; 2. MOS-specific measures, i.e. measures of actual performance on the job; 3. Army-wide measure, i.e., measures of "good soldiering" or soldier effectiveness that cut across all jobs; and 4. measures of unit effectiveness. The primary research need is for new approaches to performance assessment in each of these categories.

A85-105            TITLE: MEASUREMENT AND MODELS OF EMPLOYMENT DECISION MAKING

CATEGORY: Exploratory Development

DESCRIPTION: Each year the Army must enlist and reenlist thousands of soldiers. In order to better recruit and retain high performing soldiers, it is important to be able to understand, measure, and model the variables considered

by individuals in making their decision to join the Army or reenlist. These variables are also important in terms of the decision to enroll and continue in ROTC and to make a career as an officer in the Army.

A85-106            TITLE: RESEARCH IN PROJECTING MANPOWER AND SKILL LEVEL REQUIREMENTS  
EARLY IN WEAPON SYSTEM DEVELOPMENT

CATEGORY: Exploratory Development

DESCRIPTION: Historically, the system acquisition process has been driven by cost, adherence to schedule, and hardware/software performance. Recently, increased emphasis has been given to early identification of the human resources needed to operate and maintain the new systems. Accurate estimates of the number of individuals and the skills they must possess provide a basis for: a. comparisons with estimated future supply; b. identification of system changes to reduce operator and maintainer requirements; and c. selection among competing systems. Innovative techniques which can be used to generate quantitative and qualitative estimates of operator and maintainer requirements on the basis of information available during concept development are needed.

Procedures for estimating ability requirements are especially desired.

A85-107            TITLE: RESEARCH IN THE APPLICATION OF ARTIFICIAL INTELLIGENCE  
TECHNIQUES TO THE GENERATION OF OPTIONS IN PLANNING

CATEGORY: Exploratory Development

DESCRIPTION: It is anticipated that in tactical situations a decade or more in the future, decision makers and those planning large actions will be flooded with data, which will have to be compiled, evaluated, and analyzed for use. Efforts are needed to determine optimal use of the computer to assist in such operations. Current planning algorithms implemented on computers today do not provide options for the planner or decision maker and are not sensitive to changing constraints or environmental conditions, nor do they provide anticipated outcomes with associated probability values. Research towards the development of such systems is urgently needed.

A85-108            TITLE: RESEARCH ON COGNITIVE PROCESSES IN DECISION MAKING UNDER  
UNCERTAINTY TIME STRESS

CATEGORY: Exploratory Development

DESCRIPTION: Commanders, intelligence analysts, and others are often required to make decisions under conditions of uncertainty and severe time stress. Uncertainties may be associated with missing, incomplete, or ambiguous information, or with future outcomes that are unknown. Research is needed to 1. better understand the cognitive processes (e.g., memory, judgment, or problem-solving) of the decision maker under such conditions, and 2. suggest approaches for supporting the cognitive processes so that the overall quality and timeliness of decisions made under uncertainty and time stress are enhanced.

A85-109            TITLE: MEASUREMENT OF COMPUTER RADIATIONS FOR SECURITY REASONS

CATEGORY: Advanced Development/Non-systems

DESCRIPTION: Research and design a small portable device that can be used in the field to provide an economical and effective way to measure emanations which can be correlated to classified information being processed. This will provide the Armed Services indicators as to whether the emanations are detectable beyond the establish control space.

A85-110            TITLE: SONOBUOY TRACKING SYSTEM

CATEGORY: Advanced Development/Non-systems

DESCRIPTION: Impact scoring of missiles, bombs, and torpedoes has long been a challenge to the range instrumentation community. Bottom mounted hydrophones MILS (missile impact location system) and SDRs (splash detection radars) have been used effectively. However, in recent years the most accurate and versatile technique has been SMILS, a sonobuoy MILS. The limitation of SMILS is that the surface array of sonobuoys requires deep ocean transponders (DOT) for a geodetic reference. This limits the flexibility of the location, since the surface array can only be seeded over the DOTs. If a few selected sonobuoys in the surface array could be accurately tied to a land reference, the expendable surface array would be free of the DOT "anchor" providing complete flexibility for targeting (within sight of land).

A sonobuoy tracking system (STS) could be deployed (either by air or surface) within RF sight of a land reference and yield accurate impact scoring. The acoustic signature of the object into the water would be "heard" by the sonobuoy and the impact time and their location relayed to the shore station. By multilateration, a precise score (within 5 meters) could be derived. The problem is development of a device that would be placed on an expendable sonobuoy to track its location.

A85-111            TITLE: DEVICE FOR MEASURING RADAR BEACON DELAYS

CATEGORY: Advanced Development/Non-systems

DESCRIPTION: Tracking beacons enhance the tracking capability of radars, but the beacon delay affects the range measurement. The beacon delay is measured long before flight, but this delay changes with time and flight environment and adds error/bias to the range data. Since a considerable number of radars have the capability of tracking an object in both skin and beacon using the same transmitted RF pulse, the beacon delay can be measured. This information would improve the accuracy of the range data, as well as give data on the stability of the beacon signal. This effort should be designed and developed in such a fashion that it could be attached to certain radars as a mod with appropriate radar signal being fed in.